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L. O. HOWARD, Entomologist and Chief of Bureau.

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BY

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AND

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The two most important troubles of the fruit of the peach and other stone fruits are the so-called "brown-rot" (*Sclerotinia fructigenia* (P.) Schröt.) and the plum curculio (*Conotrachelus nenuphar* Herbst). The brown-rot is a fungous disease of the flowers, twigs, and fruit, but is especially destructive to the latter as it approaches maturity. Under weather conditions favorable to the fungus from one-half to three-fourths of the crop, or even the entire crop, may be destroyed within a few days. The marketed fruit, moreover, rarely reaches its destination in good condition and is often a disappointment to the grower as well as to the consumer. This destructive disease is well known to peach growers, especially in the Southern States, and requires but little in the way of description. Although young green fruit may become infected, it is the ripening fruit which suffers most. The disease first appears as a small brown spot, which rapidly enlarges, involving in a few days the entire fruit. On the surface of the diseased spots minute tufts of spore-bearing threads appear, giving to the fruit a grayish, moldy appearance.

The plum curculio, in the course of its feeding and egg laying, punctures the fruit, and is often so abundant that not a single fruit escapes injury. The punctures form a nidus for brown-rot spores, greatly favoring infection. Larvæ of the curculio, hatching from the eggs placed beneath the skin of the peach, make their way to the pit, and by their injury cause much of the young fruit to drop. Fruit infested later in the season may ripen prematurely and fall or be badly misshapen. Worminess of peaches in the East is entirely due to the plum curculio, and the injuries of this insect cause, in the aggregate, a loss each year to fruit growers of many thousands of dollars. As

the curculio, by its punctures, opens the way for brown-rot infection of peaches, plums, etc., its control becomes doubly important.

While the curculio is not of itself the cause of brown-rot, its work very greatly favors the disease. Furthermore, it is practically certain that the curculio distributes the spores of the fungus, and in the course of its feeding and egg laying actually infects the fruit with the fungus.

As is well known, the foliage of the peach and other stone fruits is especially sensitive to sprays, such as Paris green and Bordeaux mixture. This has largely prevented the use of Bordeaux mixture and other copper compounds for the control of peach diseases. While it has been known for several years that arsenate of lead could be used in the treatment for curculio, some injury has resulted, and on account of the well-known sensitiveness of peach foliage entomologists have been cautious about recommending it. The combination treatment for fungous diseases and insect enemies so successful in the treatment of the apple, grape, etc., has, therefore, not been possible on the peach.

The development of the self-boiled lime-sulphur mixture, however, as a fungicide has made possible the control of the brown-rot and some other peach diseases. The experiments made by the Bureau of Plant Industry, with the self-boiled lime-sulphur mixture on the peach, covering three years—from 1907 to 1909—have shown conclusively that when properly made it is perfectly harmless to the foliage, fruit, and tender growth of the peach, and that it will satisfactorily control brown-rot, peach scab, and other fungous diseases.

In experiments conducted during the past season it was found that the arsenate of lead could be combined with the self-boiled lime-sulphur mixture for spraying peaches, and that this insecticide was apparently less injurious in the combination than when used alone, and that the combination was entirely successful in controlling the scab, brown-rot, and curculio. The addition of arsenate of lead, as shown by these and other experiments, has been practically without injurious effects where not more than two applications have been made. Three applications, however, of an arsenate-of-lead spray are likely to cause shot-holing of the leaves and an excessive reddening of the fruit, and under certain weather conditions such symptoms may appear as the result of only two applications of the poison, though ordinarily not to an injurious extent. The great benefits to be derived from spraying, it is believed, will much more than offset any possible slight injury.

SOME RESULTS OF SPRAYING.[a]

In experiments conducted in the Hale orchard, at Fort Valley, Ga., during 1909, by the Department of Agriculture, the practicability of the control of peach scab, brown-rot, and the curculio was

[a] For a detailed account of these experiments, see Bulletin 174 of the Bureau of Plant Industry, U. S. Department of Agriculture.

thoroughly demonstrated. Thus a block of 1,100 Elberta trees was sprayed, first, with arsenate of lead at the rate of 2 pounds to 50 gallons of water at the time the calyces, or shucks, were shedding; second, with 2 pounds of arsenate of lead in self-boiled lime-sulphur mixture (8–8–50) three weeks later; third, with self-boiled lime-sulphur mixture alone a month later; and, fourth, with self-boiled lime-sulphur mixture a month before the ripening period of the fruit. At picking time 95.5 per cent of the fruit from the sprayed block was free from brown-rot, 93.5 per cent free from scab, and 72.5 per cent free from the curculio. On the unsprayed block only 37 per cent of the fruit was free from brown-rot, 1 per cent free from scab, and 2½ per cent free from curculio injury. In packing the fruit for market it was found that the amount of merchantable fruit on the sprayed block was ten times as great as from the unsprayed block containing the same number of trees.

On a block of Waddell trees sprayed with the self-boiled lime-sulphur mixture alone, one month after the falling of the petals and again one month before the fruit ripened, the results were not quite so good, owing to curculio infestation; but the yield of merchantable fruit was, nevertheless, 100 per cent more than that on a similar block of unsprayed trees of the same variety.

From these results and those of previous experiments we may conclude that the peach grower now has at his command a reasonably safe and thoroughly effective remedy for the peach scab, brown-rot, and curculio. By carefully following the instructions given below he should be able effectively to prevent these troubles at a small cost.

PREPARATION OF THE SPRAY MIXTURES.

The sprays to be employed are the self-boiled lime-sulphur mixture and arsenate of lead. The arsenical is added to the lime-sulphur mixture, permitting the treatment of both brown-rot and the plum curculio at one and the same time.

Self-boiled lime-sulphur mixture.—This mixture is composed of 8 pounds of fresh stone lime and 8 pounds of sulphur (either flowers or flour may be used) to 50 gallons of water. This appears to be about the correct strength, although in mild cases of scab and brown-rot a weaker mixture, containing 6 pounds of each ingredient to 50 gallons of water, may be used with satisfactory results. The mixture can best be prepared in rather large quantities—say, enough for 200 gallons at a time, making the formula 32 pounds of lime and 32 pounds of sulphur to be cooked with a small quantity of water (8 or 10 gallons) and then diluted to 200 gallons.

The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulphur should be added after first running it through a sieve to break up the

lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted, and applied.

The stage at which cold water should be poured on to stop the cooking varies with different limes. Some limes are so sluggish in slaking that it is difficult to obtain enough heat from them to cook the mixture at all, while other limes become intensely hot on slaking and care must be taken not to allow the boiling to proceed too far. If the mixture is allowed to remain hot fifteen or twenty minutes after the slaking is completed, the sulphur gradually goes into solution, combining with the lime to form sulphids, which are injurious to peach foliage. It is therefore very important, especially with hot lime, to cool the mixture quickly by adding a few buckets of water as soon as the lumps of lime have slaked down. The intense heat, violent boiling, and constant stirring result in a uniform mixture of finely divided sulphur and lime, with only a very small percentage of the sulphur in solution. It should be strained to take out the coarse particles of lime, but the sulphur should be carefully worked through the strainer.

Arsenate of lead.—Arsenate of lead comes on the market in a thick, putty-like paste, and must be worked free in water before addition to the lime-sulphur mixture. There are several brands upon the market and the grower should be careful to purchase from reliable firms. The addition of arsenate of lead to the self-boiled lime-sulphur mixture will bring about a decided change in color, but without injuriously affecting the value of the spray. Arsenate of lead is used at the rate of 2 pounds to each 50 gallons of water or lime-sulphur mixture.

The amount of poison required for each spray tank of mixture may be weighed out into a bucket, thinned with water, and poured through a strainer into the spray tank. In extensive operations, however, it is much more convenient to prepare a stock mixture in advance. Place 100 pounds of the material in a barrel with a bucket of water and work it into a thin paste with a spade or a large paddle, then dilute with water to make exactly 25 gallons. When thoroughly stirred, each gallon will contain 4 pounds of arsenate of lead, and the amount of poison for each spray tank of mixture may be measured, thus avoiding the trouble of weighing small lots.

SCHEDULE OF APPLICATIONS.

For the Elberta, Bell, Reeves, and other varieties of peaches of about the same ripening season, the following is advised:

First application.—About the time the calyces, or shucks, are shedding from the young fruit, spray with arsenate of lead at the rate of

2 pounds to 50 gallons of self-boiled lime-sulphur mixture. Since this application is rather early for scab, and since serious outbreaks of brown-rot do not usually occur at this time, the self-boiled mixture may be omitted in many cases with reasonable safety. But during warm, rainy springs, especially in the South, the lime-sulphur mixture will doubtless be necessary in this application. In case the self-boiled lime-sulphur mixture is not used there should be added to each 50 gallons of water the milk of lime made from slaking 2 or 3 pounds of good stone lime, in order to counteract any caustic action of the arsenate of lead.

Second application.—Two or three weeks later, or about one month after the falling of the petals, spray with the 8–8–50 self-boiled lime-sulphur mixture and 2 pounds of arsenate of lead.

Third application.—About one month before the fruit ripens spray with the 8–8–50 self-boiled lime-sulphur mixture, omitting the poison.

For earlier maturing varieties of peaches, such as Waddell, Carman, and Hiley, the first two treatments outlined above will usually be sufficient, but in very wet seasons badly rotting varieties would probably require three treatments. Late varieties, such as Smock and Salway, having a longer season, would not be thoroughly protected by three applications, but on account of the expense there is hesitation in recommending a fourth spraying. In view of the results obtained on midseason varieties, it seems likely that three treatments will ordinarily be sufficient for the late varieties.

APPLICATION OF THE SPRAY MIXTURE.

During the operation of spraying, the mixture should be kept well agitated. Owing to the tendency of the self-boiled lime-sulphur mixture and the arsenate of lead to settle readily, this point can not be too strongly emphasized. If the spraying outfit is not equipped with a good agitator, the spray will not be evenly distributed, with the result that some of the trees will be oversprayed while others will receive an insufficient application. The early applications of spray should be made rather heavy and very thoroughly to insure the destruction of the curculio and protection against scab. The last spraying, a month before ripening time of the fruit, should be made with fine nozzles, the object being to give the fruit a uniform coating of a mistlike spray. Heavy drenching of the trees at this time should be avoided, to guard as much as possible against the staining of the fruit at picking time.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *February 25, 1910.*

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